

May 14, 2002

MEMORANDUM FOR: John Williams
Assistant Project Director, Survey Section C

FROM: Charles W. Challstrom
Director, National Geodetic Survey

SUBJECT: INSTRUCTIONS: Puerto Rico FBN and Ties to the
CORS Site in Isabela (GPS-1682)
Task Numbers: 8K6D4000 (CORS)
8K6D2000 (FBN)

GENERAL:

The National Geodetic Survey (NGS), in accordance with the NGS Strategic Plan, is engaging in a campaign of observing stations of the Federal Base Network (FBN) to complete the ellipsoidal and orthometric height components of the FBN. This survey will observe 3 FBN stations and 16 CBN stations in Puerto Rico. In addition NGS has established survey stations at the Puerto Rico Continuously Operating Reference Station (CORS) site near Isabela, Puerto Rico. These stations must be tied to the CORS antenna at the site, as well as to the local Federal Base Network/Cooperative Base Network (FBN/CBN) through GPS observations. The CORS at this site serves as a Nationwide Differential (NDGPS) site for the U.S. Coast Guard. This project will require three dual-frequency GPS receivers. Precise leveling has previously been done.

PURPOSE:

In order to meet America's accelerating positioning and navigation needs, the existing coordinate reference system must be continually enhanced to provide the accessibility and high accuracy required for use with GPS. The digital revolution in mapping, charting, and surveying requires a National Spatial Reference System (NSRS) consist-ing of, among other components, a network of monumented points having four-dimensional positions. The FBN fulfills the requirements for this component. NGS is charged with the Federal responsibility for establishment, observation, monitoring, and maintenance of the FBN. The FBN provides the critical network foundation for an accurate, consistent, reliable NSRS.

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The NSRS, in turn, provides the common geographic framework for America's spatial data infrastructure. As such, the NSRS serves as the basis for mapping, charting, navigation, boundary determination, property delineation, infrastructure development, resource evaluation surveys, and scientific applications, including crustal motion monitoring, modeling of flooding, storm surge, pollution trajectories, and agricultural runoff. A modernized, accurate, consistent, reliable NSRS is of enormous benefit to state, county, tribal, local, and Federal authorities, as well as to the private sector.

The stations established at the site will provide a very accurate tie to the antenna as an aid to quickly reposition the antenna should it become necessary. The FBN/CBN tie observed during this project will also provide site station coordinates relative to the local FBN/CBN, thus reducing the potential for relative error between the stations and the local network. It will also provide a check on the FBN/CBN, relative to the CORS coordinates. The leveling will establish very accurate NAVD 88 heights for the survey stations at the CORS site.

GPS SPECIFICATIONS:

Specific to this project is that at the site, 2 sessions of 2 hours (minimum) shall be observed at AGUA USCG B and the primary bench mark at tide gage 9755371, A Tidal, (PID TV1513), located at the U.S. Coast Guard station at La Puntilla, San Juan. In order to provide a check, the equipment shall be broken down and reset with a minimum of 30 minutes between the two sessions. Also to be done are 3 sessions of 5.5 hour observations to the three FBN stations AGUA USCG A, EL OJO, and ZSU B and the 16 CBN stations. The survey party shall check the NGS CORS Web page for information regarding CORS data availability immediately before and after the collection of GPS data. Data from the CORS site must be available for the scheduled occupation, otherwise, reobservations will be required.

Station occupation and observing procedures shall be carried out in accordance with the "NGS Operations Handbook" and appropriate equipment user manuals.

Data formats and digital file definitions are given in "Input Formats and Specifications of the National Geodetic Survey Data Base," Volume I, Horizontal Control Data, Federal Geodetic Control Subcommittee, September 1994. Success in meeting the accuracy standards will be based on repeatability of measurements, adjustment residuals, and analysis of loop misclosures.

General specifications for the project are given in "Geometric Geodetic Accuracy Standards and Specifications for Using GPS Relative Positioning Techniques," Version 5.0: dated May 11, 1988, reprinted with corrections August 1, 1989.

GPS DATA ACQUISITION:

Data collection shall be accomplished at 15-second epoch intervals referred to the minute. The Trimble 4000 series receivers must collect data in the compressed mode as specified in the Trimble users manual. Track satellites down to a 10-degree elevation angle.

Record weather data at the beginning and end of the session. Meteorological data shall also be collected immediately after an obvious weather front passes during the session and immediately before it passes, if possible. Atmospheric pressure and relative humidity measurements must be made at approximately the same height as the GPS antenna phase center. Record on the observing log the time and place that the weather data were gathered.

Antenna set-up is critical to the success of this project. Fixed-height tripods are preferred for all receivers. The plumbing bubbles on the antenna pole of the fixed-height tripod must be shaded when plumbing is performed. Plumbing bubbles must be shaded for 3 minutes before checking and/or re-plumbing. The perpendicularity of the poles must be checked at the beginning of the project and any other time there is suspicion of a problem.

When a fixed-height tripod is not used, the height of the antenna must be carefully measured to prevent station set-up blunders. Tribrachs used for these set-ups must be checked and adjusted when necessary. Totally independent measurements of the antenna height above the mark in both metric units and English units must be made before and after each session. Someone other than the observer must check the measurement computations by carefully comparing measurements and then entering his/her initials on the log.

A legible rubbing of the marks must be made at the time of the first occupation of a station. When not feasible to make the required rubbing, a plan sketch of the mark must be substituted, accurately recording all markings. In addition, a layout sketch of the facility should be made. Include the location of the marks, antennae, buildings, and any other identifying characteristics of the area on the sketch, as well as the approximate height of the CORS antenna. Take photographs of the CORS antenna, site layout, reference stations, and any unusual situations.

The success of this project requires that the highest quality GPS data be collected. Therefore, during each station occupation, the operators shall carefully monitor the operation of the receivers. Any irregularities in the data due to equipment malfunction, DOD adjustment of the satellite orbit, obstructions, etc., must be reported to N/NGS41 as soon as possible. If the quality of observations for an observing session is questionable, notify N/NGS41.

VECTOR COMPUTATIONS:

Data management, quality review, and final vector processing will be accomplished using PAGES. Vectors will be computed in the International Terrestrial Reference Frame (ITRF) using the most current epoch and precise ephemerides. Use 30-second epoch interval for processing. The GPS data and positions for the antenna are available from NOAA's CORS GPS network. Monument positions will be used for CORS when available, otherwise, antenna reference point (ARP) positions will be used as the reference station. Use 15 degrees as the cutoff angle in data processing. A cutoff angle of 10 degrees may be used when necessary to improve results.

The type of final solution, L1 versus ion-free, will depend on the length of the vectors. For vectors from the antenna to the other stations at the site that are less than 5 km in length, the final reduction will consist of an L1 fixed solution. For the local FBN/CBN tie, there will be vectors computed from the antenna to the ties which are greater than 5 km in length. These vectors will be computed in a separate processing session from the short (less than 5 km) vectors.

In general, vectors greater than 10 km in length are to be computed in an ion-free fixed, or partially-fixed, solution. In all cases, integer ambiguities will be fixed for each vector whenever possible.

The quality of collected data shall be determined from the plots generated from PAGES and by analysis of repeated vectors and/or comparison of station positions, and free adjustment residuals and/or loop misclosures.

Survey Section B will perform all quality checks for conformance with NGS format standards such as executing software programs COMPGB, OBSCHK, and OBSDES. The final ITRF vectors will be assessed and transformed to the NAD 83 coordinate system using program ADJUST. The NAD 83 position for the CORS antenna will be used in the adjustments as the constraint. For the other stations, compare the computed NAD 83 positions to the published NAD 83 positions, if available.

The data and results will be submitted to the Observation and Analysis Division. All B-files and G-files must be complete, including *25* and *27* records.

GPS DATA:

Observing windows shall be selected and modified as necessary, to maximize satellite visibility for each session.

The project report and GPS data listed in Appendix L, Volume I, of "Input Formats and Specifications of the NGS Data Base" must be transmitted to the Field Operations Branch. Any data considered suspect as to quality in achieving accuracy standards should be sent by FedEx or express mail immediately for office review. Backups of transmitted data must be held until notified by the Field Operations Branch.

For the PUERTO RICO project, the data set collected shall be named "prgp052d.960". All records in connection with the project shall be titled "PUERTO RICO FBN AND TIES TO THE CORS SITE IN ISABELA, 2002". The project number is GPS-1682.

STATION DESCRIPTIONS:

Station recovery notes must be submitted in computer-readable form using WDDPROC software. Include the name, address, and, if public ownership, the telephone number of the responsible party. Do not include the telephone numbers of private property owners.

LIAISON:

The street address of the following NGS offices in Building SSMC3 is:

1315 East-West Highway
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Questions concerning survey operations shall be directed to:

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Questions concerning the GPS portion of the project shall be directed to:

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Spatial Reference System Division
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Questions and problems concerning adjustment processing should be directed to:

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Questions and problems concerning vector processing should be directed to:

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Coast Guard DGPS Site Isabella
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The Geodetic Coordinator for Puerto Rico is:

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ADDRESS:

Keep the Field Operations Branch informed of the party's physical address and telephone number at all times.

PUBLICITY:

See "NGS Operations Handbook," Section 1.4.1.

EXPENSES:

Expenses for this project will be charged to Task Numbers 8K6D4000 (CORS) and 8K6D2000 (FBN).

TRAVEL:

Travel and per diem are authorized in accordance with Federal Travel Regulations, Part 301-11, Per Diem Allowances. Current per diem rates were effective October 1, 2001.

ACKNOWLEDGMENT:

Please acknowledge receipt of these instructions in your Monthly Report.

Attachments

cc: N/NGS - D. Zilkoski
 N/NGS - S. Misenheimer (first page only)
 N/NGS - D. Milbert
 N/NGS1 - G. Mitchell (first page only)
 N/NGS11 - S. Cofer
 N/NGS2 - E. McKay
 N/NGS2 - D. Doyle
 N/NGS21 - S. Frakes
 N/NGS21 - C. Craig (first page only)
 N/NGS21 - D. Hendrickson
 N/NGS4 - E. Wade
 N/NGS4 - D. Hoar
 N/NGS4 - M. Vorhauer
 N/NGS41 - W. McLemore
 N/NGS41 - J. Blackwell
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